

REMARKS

Claims 86-88, 90-162, 224-227, 270-272, 287 and 288 are pending in the subject application. Claims 140-150, 159-162, 224-227 and 270 have been withdrawn from consideration. In the Office Action, claims 86-88, 90-139, 151-158, 271, 272, 287 and 288 stand rejected. Specifically in the Office Action, claims 86-88, 90-139, 287 and 288 stand rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent Nos. 5,945,491 or 6,111,022 to Matyjaszewski et al. ("the '491 patent" and "the '022 patent", respectively). In addition, claims 151-158 and 271-272 stand rejected under 35 U.S.C. 103(a) as being obvious over the '491 patent in view of Patten et al., "Atom Transfer Radical Polymerization and the Synthesis of Polymeric Materials," *Adv. Mat.*, 1998, 10(12), 901-915 ("Patten"). Applicants traverse these rejections as set forth herein.

Claim 151 has been amended to clarify the arm-first process for forming the star copolymer. Support for this amendment may be found in the specification as filed, for example, at Scheme 5, page 36. Claim 287 has been amended to include a listing of solvents originally in claim 288. Claim 288 has been canceled. No new matter is added by these amendments.

Rejection under 35 U.S.C. § 102(e)

Claims 86-88, 90-139, 287 and 288 stand rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent Nos. 5,945,491 (the '491 patent) or 6,111,022 (the '022 patent) to Matyjaszewski et al. (collectively, "the Matyjaszewski patents"). Applicants respectfully traverse this rejection for the reasons set forth herein.

First, the Office states that the Matyjaszewski patents disclose:

adding a coupling compound containing one or more  $\alpha,\alpha$ -disubstituted olefin group(s) to the first polymer in the presence of a transition metal complex capable of undergoing a redox reaction with first radically transferable atom or group, ... and an elimination reaction comprising the radically transferable atom or group to form a reactive double bond.  
(Office Action, page 6)

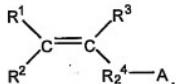
as required by independent claims 107 and 118 and claims dependent therefrom.  
Applicants respectfully disagree.

First, Applicants note that neither of the Matyjaszewski references disclose either explicitly or implicitly "an elimination reaction involving the radically transferable atom or group to form a reactive unsaturated group" as set forth in claims 107 and 118. The Office references Scheme 3 of the '491 as showing an elimination reaction. However, Scheme 3 and the specification of the Matyjaszewski patents do not disclose an elimination reaction to form a reactive double bond. Instead, Scheme 3 displays the copolymer structure from the repeated addition of methyl methacrylate monomer to a polystyrene macroinitiator resulting in a copolymer having a terminal chloro group. Because of the structure (for example the adjacent ester functionality), this terminal chloro group undergoes further ATRP polymerization rather than an elimination reaction. Indeed, the purpose of Scheme 3 of the '491 patent is to "synthesize a block copolymer by combining a 'living' carbocationic polymerization with a 'living' radical polymerization." (The '491 patent at column 15, line 15, to column 16, line 1). In Scheme 3, the terminal chloro group acts as a radically transferable atom or group in subsequent polymerization reactions and its removal by an elimination reaction to form a reactive unsaturated group would run counter to the purpose of the Scheme.

Further, claim 118 also requires "adding a coupling compound containing one or more  $\alpha,\alpha$ -disubstituted olefin group(s) to the first polymer" and additionally requires the step of "allowing a second polymer having a second radically transferable atom or group in the presence of the transition metal complex to add to the reactive double bond." These elements are not disclosed in the Matyjaszewski patents. As set forth above, the Matyjaszewski patents do not disclose "an elimination reaction ... to form a reactive double bond". Therefore, they clearly cannot disclose subsequently "allowing a second polymer ... to add to the reactive double bond." In addition, the subject application describes the coupling compounds as "non-polymerizable monomers, such as an  $\alpha,\alpha$ -disubstituted olefins" (see page 23, lines 16-17) which are used to affect the coupling process (as described in detail in Figure 6) by undergoing an elimination reaction to form a reactive double bond after addition to the site of the first radically transferable atom or group. The methyl methacrylate disclosed in Scheme 3 of the '491 patent cannot be a coupling compound since (a) it is not a non-polymerizable monomer (Scheme 3 of the '491 patent shows it acting as a polymerizable monomer) and (b) it

does not undergo an elimination reaction under the polymerization conditions. To anticipate a claim under Section 102, the cited reference must teach each and every element of the claim (see, MPEP § 2131). Therefore, claims 107 and 118 and all claims dependent from claims 107 and 118 cannot be anticipated by the Matyjaszewski patents.

The Office also maintains that structure (V) of the '491 patent is defined broadly to "include a compound that is not a free radically polymerizable monomer, such as a vinyl alkyl ketone." (Office Action, page 6). Applicants respectfully disagree. Structure (V) on column 22, lines 34-64 of the '491 patent does not disclose a structure that is not a free radically polymerizable monomer such as a vinyl alkyl ketone. Close examination of structure (V) of the '491 patent shows that it cannot represent a vinyl alkyl ketone as maintained by the Office. Structure (V) is defined as:



The Office maintains that this structure includes vinyl ketones presumably since A is defined as including  $C(=Y)R^5$ , where Y is O. Applicants note, however, that structure (V) requires an  $R_2^4$  group between the olefin and the A group.  $R_2^4$  is defined as "an organic spacer group" (see column 22, lines 43-44) which means that the A group is separated from the vinyl moiety by an organic group and cannot be a vinyl ketone (which requires a direct bond between the olefin carbon and the carbonyl carbon of the ketone).

Next, the Office has reintroduced the assertion that the '491 patent discloses the use of alpha-methyl vinyl methyl ketone in Table 5, column 31, contending that alpha-methyl vinyl methyl ketone is not a free radically polymerizable monomer. As previously argued, the chemical formula in Table 5 represents a typographical error where a subscript "2" in the ester functionality was inadvertently omitted. Applicants addressed this issue by submitting a Declaration by inventor Coca of the '491 patent and the '022 patent in the Response dated April 27, 2007, establishing the typographical error with accompanying documentary evidence showing correction of the error in a published article. In the subsequent Action of June 28, 2007, the Office removed the assertion

regarding the incorrect structures of Table 5 of the '491 patent. However, in the present Action, the Office has reintroduced the assertion regarding Table 5 but has not addressed the evidence presented in the Declaration and explained why it is now considered to be insufficient, as required by the MPEP.

Evidence traversing rejections must be considered by the examiner whenever present. ... Where the evidence is insufficient to overcome the rejection, the examiner must specifically explain why the evidence is insufficient. (MPEP § 716.01, emphasis added)

Further, Applicants draw the Office's attention to the fact that requests for Certificates of Correction have been filed in both the '491 patent and the '022 patent correcting the structures presented in Table 5. As set forth in the Patent Law, "(s)uch patent, together with the certificate, shall have the same effect and operation in law on the trial of actions for causes thereafter arising as if the same had been originally issued in such corrected form." (35 U.S.C. § 255). One having ordinary skill in the art reading the disclosure in light of the Certificate of Correction would understand that the monomer set forth in Table 5, Exp 4 was methyl methacrylate and not alpha-methyl vinyl methyl ketone. In view of the previously submitted Declaration and the pending Certificates of Correction in the cited patents, Applicants request withdrawal of the Office's assertion regarding the incorrect structures in Table 5 of the published Matyjaszewski patents.

With reference to pending claims 287 and 288, claim 287 has been amended to include the polar solvents: methanol, ethanol, acetone, and mixtures thereof. Applicants have discovered that the addition of low concentrations of a polar solvent can increase the level of control of the polymerization (see page 93, lines 1-9 and Table 16 of the subject application as filed). Applicants submit that neither the '491 patent nor the '022 patent disclose a polymerization process comprising a polar solvent in a concentration of 5 wt% to 10 wt% of the system. Further, the discussion of suitable solvents in Matyjaszewski patents (see column 14, line 28 to column 15, line 10) does not disclose the claimed solvents or any other alcohol or ketone solvent. Therefore, claim 287 cannot be anticipated by the Matyjaszewski references.

The Office also maintains that claims 107-139, 287 and 288 as written "do not require the second compound to be not free radically polymerizable" (Office Action,

page 6), relying in part on the absence of this limitation to ignore Applicants arguments. However as discussed above, the claimed processes require at least either an elimination reaction to form a reactive bond or small amounts of a polar solvent. Since these elements are not explicitly or implicitly disclosed in the Matyjaszewski patents, further requiring the second compound to be not free radically polymerizable is unnecessary to avoid anticipation.

As discussed herein, all the features of claims 86-88, 90-139, and 287 are not described, either explicitly or implicitly in the Matyjaszewski patents. Therefore, the Matyjaszewski patents cannot anticipate the claims of the subject application. Withdrawal of the rejections under 35 U.S.C. § 102(e) is respectfully requested.

Rejections under 35 U.S.C. § 103(a)

Claims 151-158 and 271-272 stand rejected under 35 U.S.C. § 103(a) as being obvious over the '491 patent in view of Patten et al., "Atom Transfer Radical Polymerization and the Synthesis of Polymeric Materials," *Adv. Mat.*, 1998, 10(12), 901-915 ("Patten"). Applicants traverse this rejection for the reasons set forth herein.

The Office maintains that the claimed process differs from the '491 patent as lacking a core forming compound or multi-armed star copolymers. The Office states that Patten discloses a core forming compound and that multi-armed star copolymers can be prepared by ATRP.

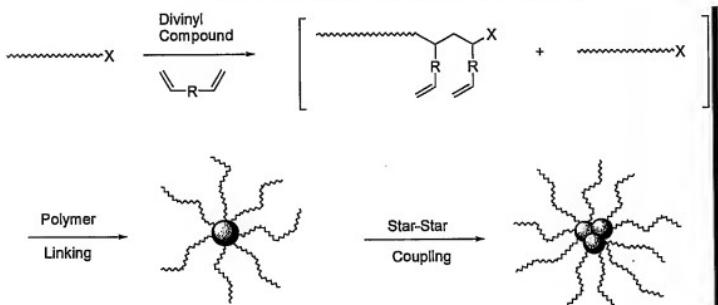
As set forth in Applicant's Response dated September 28, 2007, claims 151-158 and 271-272 of the subject application describe an "arm-first" approach to the synthesis of a multi-arm star copolymer whereas the cited references, at best, disclose a step-wise approach to star copolymers. Even though the cited references may disclose using ATRP technology to form star copolymers, claims 151-158 and 271-272 describe a different ATRP process to make the star copolymers (i.e., the arm-first approach). Neither of the cited references discloses an arm-first approach to the formation of star copolymers and thus the claims are novel and non-obvious over the references.

The Office asserts that the claims as written do not support the argued differences between the "arm-first" approach and the "step-wise" approach. Applicants respectfully disagree but have amended claims 151 to more clearly indicate that the

process involves "reacting polymer chains having a radically transferable atom or group with the core forming compound to form the multi-arm star copolymer" as required by the arm-first approach. Neither the '491 nor Patten disclose, teach or suggest this step. Indeed, the initiators described by the '491 patent and Patten all include radically transferable atoms or groups (see column 10, line 45 to column 11, line 53) which cannot react with polymer chains having a radically transferable atom or group.

The "arm-first" approach is schematically represented in Scheme 5 (page 36 of the subject application as filed) which comprises reacting polymer chains having a radically transferable atom or group with the core forming compound to form the multi-arm star copolymer.

Arm-First Approach (Scheme 5, page 36)



In contrast, the ATRP processes disclosed in the '491 patent and/or Patten involve chain growth polymerization from an initiator (i.e., step-wise growing the arms – monomer by monomer – from the initiator comprising a monovinyl group and a radically transferable atom or group). For example, see Scheme 5 of the '491 application (column 23) or Scheme 6 of Patten (page 913), which illustrate forming a hyperbranched polymer via step-wise arm growth. The initiator of these references cannot undergo an arm-first growth process to form a star copolymer since it lacks two or more vinyl groups.

In addition, neither the '491 patent nor Patten disclose or suggest the use of a divinyl compound as a core forming compound as required by claim 153 and claim 271

(both references use a monovinyl initiator). Therefore, the cited references do not teach or suggest each and every step of the processes of the rejected claims.

The star polymers formed by these different processes will have different characteristics. For example, the star polymer formed by step-wise addition of monomer units results in a star polymer with atom transferable units (i.e., X) at the terminus of each arm at the periphery of the polymer, whereas the arm termini of the arm-first approach can have different functionality (or no functionality) (see, page 36, line 15 to page 39, line 6 of the application as filed). Also, because the polymer "arms" have been pre-formed, the claimed process allows greater control over the functionality on the arm terminus, the molecular weight of each arm, and the molecular weight distribution of each arm. The prior art approaches do not possess this control element, nor are these elements obviously controllable using the step-wise approach. Further, the arm-first process of the subject application has the advantage of having transferable atoms within the core of the molecule which can be used for the polymerization of a second set of arms using a different monomer to prepare a mikto-arm type star polymer (see page 37, line 28 to page 38, line 2). The arms of the mikto-type star polymer will have different phyllicities and allow dispersion in solvents of different polarity. In addition, the presence of a transferable atom within the core of the molecule may be used to initiate star-star coupling as seen in Scheme 5, page 36. Star polymers formed by a step-wise approach will have none of these features.

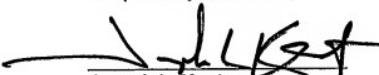
One having ordinary skill in the art would not be motivated by the disclosure of the '491 patent or Patten to form a multi-arm star copolymer by an "arm-first" process comprising reacting polymer chains having a radically transferable atom or group with a core forming compound. Further, neither the '491 patent nor Patten teach or disclose a core forming divinyl compound. Therefore, *prima facie* obviousness has not been established and the cited references cannot render obvious the processes of claims 151-158 and 271-272. Applicants respectfully request that the rejection under 35 U.S.C. § 103(a) be withdrawn.

CONCLUSION

Applicants submit that claims 86-88, 90-139, 151-158, 271-272 and 287 of the subject application recite novel and non-obvious processes for forming polymers. Applicants respectfully request that the Examiner consider the Amendments and Remarks submitted herein for further examination of the subject application. Applicants submit that all claims in the subject application are in condition for allowance. Accordingly, reconsideration of the rejection and allowance of all pending claims is earnestly solicited.

If the undersigned can be of assistance to the Examiner in addressing issues to advance the application to allowance, please contact the undersigned at the number set forth below.

Respectfully submitted,



Joseph L. Kent

Registration No. 54,216

K&L GATES LLP  
Henry W. Oliver Building  
535 Smithfield Street  
Pittsburgh, PA 15222-2312  
Telephone: (412) 355-8315  
Facsimile: (412) 355-6501

Customer No. 26,285